Review Outline Midterms Weeks 1-2.5
Chemistry 1B-AL, Fall 2016

see Study Guide 1-3: http://switkes.chemistry.ucsc.edu/teaching/CHEM1B/Fall16AL/CHEM1BAL_2016F_worksheets.html

---------- Chapter 12 ----------

I. Experiments and findings related to origin of quantum mechanics

A. Planck: $E=h\nu$, $\lambda\nu=c$
B. Davisson-Germer (electrons diffract; behave as waves)
C. DeBroglie $p\lambda=h$
D. Photoelectric effect (phot
E. Uncertainty Principle $(m\Delta u)\ (\Delta x) \geq h/4\pi$
F. Meaning of the "electron wave"
G. Bohr and Rydberg and hydrogen atom
   [$E=-2.18 \times 10^{-18}$ J $(1/n^2)$]
   emission [$-\Delta E_{Hatom} = h\nu_{photon} = hc/\lambda = 2.18 \times 10^{-18}$ J $(1/n^2_1 - 1/n^2_2)$] $(n_2 > n_1)$
   [$(1/\lambda) = 1.097 \times 10^7$ m^{-1} $(1/n^2_1 - 1/n^2_2)$] $(n_2 > n_1)$]

II. Quantum mechanics of the hydrogen atom

A. Wavefunction for an electron (Ψ), probability (Ψ^2), and radial probability ($4\pi r^2\Psi^2$)
B. Quantum numbers n, ℓ, m_ℓ of allowed orbitals
   1. n = 1, 2, 3, …
   2. ℓ = 0, 1, 2, … (n-1) [s, p, d, f, …]
   3. $m_\ell = -\ell \ldots +\ell$ [$(2\ell + 1)$ components (values of m_ℓ) for each ℓ]
C. Pictures of the orbitals and nodes
   1. (n-ℓ-1) radial nodes
   2. ℓ angular nodes
   3. s, p_x, p_y, p_z, d_{z2}, d_{x2-y2}, d_{xy}, d_{xz}, d_{yz}
D. Meaning of the n, ℓ, m_ℓ quantum numbers
   1. n- energy, radial nodes, average distance of electron from nucleus
   2. ℓ- shape of orbital
   3. m_ℓ - orientation of orbital

III. Many-electron atoms and ions

A. Stern-Gerlach and electron spin ($m_s = +1/2$ ↑, $m_s = -1/2$ ↓)
B. Pauli exclusion principle
C. Z_{eff} and shielding by inner electrons and electrons in same shell
D. $E \approx -2.18 \times 10^{-18}$ J (Z^2_{eff}/n^2)
E. $r \approx (0.529 \times 10^{-10}$ m$)\ (n^2/Z_{eff})$
F. Z_{eff} of 2s > Z_{eff} of 2p due to penetration
G. $E_{2s} < E_{2p}$
H. $E_{3s} < E_{3p} < E_{3d}$
I. Mnemonic diagram for energy ordering in neutral atoms (e.g. $E_{4s} < E_{3d}$)
J. In transition metal cations $E_{3d} < E_{4s}$ (Z_{eff} vs n)
K. Aufbau principle, Hund's Rule, and atomic configurations
L. Ground, excited, and not allowed configurations

To Here Midterm #1